

**REMARKS**

**I. Introduction**

In response to the pending final Office Action and Advisory Action, Applicants have amended claim 1 to further clarify the subject matter of the present disclosure. The limitations of claim 8 were incorporated into claim 1. Claim 8 has been cancelled, without prejudice. No new matter has been added.

Applicants respectfully submit that all pending claims are patentable over the cited prior art for the reasons set forth below.

**II. The Rejection of Claims 1, 4, 6 and 8 Under 35 U.S.C. § 112**

Claims 1, 4, 6 and 8 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. It is asserted that the amendments to claim 1 reciting the total thickness of the separator being between 18 and 30  $\mu\text{m}$  is not supported in the specification.

In response, Applicants have amended claim 1 to recite that a total thickness of said porous film and said non-woven fabric is not less than 15.5  $\mu\text{m}$  and not more than 30  $\mu\text{m}$ , which is supported by Table 1. For example, as shown in Table 1, the thickness of the porous film of Example 3 is 0.5  $\mu\text{m}$  and the thickness of the non-woven fabric separator of Example 10 is 15  $\mu\text{m}$ . Adding these thicknesses makes for a combined 15.5  $\mu\text{m}$ . As such, the specification does support a total thickness of a porous film and non-woven fabric of from 15.5  $\mu\text{m}$  to 30  $\mu\text{m}$ . In view of these remarks, Applicants respectfully request that the § 112 rejection be withdrawn.

**III. The Rejection Of Claims 1, 2, 4, 6 and 8 Under 35 U.S.C. § 103**

Claims 1, 2, 4, 6 and 8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamashita et al. (USP No. 6,287,720) in view of Fujiwara et al. (USP No. 6,576,366) and Shi et al. (US 2005/0014063); claims 1, 2, 4 and 8 as being unpatentable over Miyasaka (USP No. 5,869,208) in view of Nakamizo et al. (US 2001/0004502) and Shi; and claim 6 as being unpatentable over Miyasaka in view of Shi and further in view of Susuki et al. (US 2002/0037450). Applicants respectfully traverse these rejections for at least the following reasons.

With regard to the present disclosure, amended independent claim 1 recites a cylindrical lithium secondary battery having a design capacity density of 114 mAh/cm<sup>3</sup> or more comprising a positive electrode comprising a composite lithium oxide, a negative electrode comprising a material capable of absorbing and desorbing lithium, a separator interposed between the positive electrode and the negative electrode, and a non-aqueous electrolyte. The separator comprises a non-woven fabric having a melt-down temperature of 150°C or more. A porous film having a thickness of not less than 0.5 µm and not more than 10 µm adheres to the surface of the positive electrode and/or the negative electrode. The non-woven fabric has a thickness of not less than 15 µm and not more than 25 µm, a total thickness of the porous film and the non-woven fabric is not less than 15.5 µm and not more than 30 µm. The non-woven fabric comprises an inorganic oxide filler and a binder.

It is admitted that Yamashita fails to teach or suggest the claimed thicknesses of the non-woven fabric and the porous film layer. However, the Examiner has found that the combined thickness of the separator 13A, 13B in Example 6 is 25 µm. From this, the Examiner alleges that the portion of the separator 13A is a heat resistant layer falling in the claimed thickness of 0.5 to

20  $\mu\text{m}$ , and the portion 13B being a non-woven fabric falling in the claimed thickness of 15-50  $\mu\text{m}$ . Moreover, it is also admitted that Miyasaka fails to specifically teach or suggest the use of a non-woven fabric in the separator. However, it is alleged that it would be obvious to replace a non-woven separator for a woven separator in Miyasaka.

In response, Applicants would point out that the cited prior art in no way teaches a thin non-woven fabric with a thickness of 15-25  $\mu\text{m}$ , and a total thickness of said porous film and said non-woven fabric is not less than 15.5  $\mu\text{m}$  and not more than 30  $\mu\text{m}$ .

Furthermore, Applicants have amended claim 1 to recite that the battery is a cylindrical lithium secondary battery having a design capacity density of 114 mAh/cm<sup>3</sup> or more. This is otherwise known as cylindrical 18650 battery, support for which is recited in the Comparative Example 1 of the present specification. A cylindrical 18650 battery has a high volumetric efficiency and a structure prone to short circuits and heat generation in an abnormal condition. Spirally wound batteries are more prone to accumulation of heat compared to laminated batteries and have a structure in which heat is easily generated. As such, a skilled artisan would not be motivated to use a non-woven fabric with a thickness of 15-25  $\mu\text{m}$  in this kind of battery, as evident from Comparative Example 1 of Table 1.

For all the batteries in the Examples which satisfy that the non-woven thickness is 15-25  $\mu\text{m}$ , the heat-resistant layer thickness is from 3-10  $\mu\text{m}$ , and the total thickness is from 18-30  $\mu\text{m}$ , the battery capacity is 1890 mAh or more, or 114 mAh/cm<sup>3</sup>. Further, for support in the specification, the heat-resistant layer is from 0.5-10  $\mu\text{m}$ , and the total thickness is from 15.5-30  $\mu\text{m}$ . In addition, the lower limit of filler content is 90%.

Yamashita teaches a laminated battery. However, its volumetric efficiency is unknown. Moreover, Fujiwara and Miyasaka both disclose a non-woven fabric separator for a cylindrical

battery. However, both references teach a negative electrode made of an alloy. As such, since a negative electrode made of alloy expands and contracts greatly, short circuits occur often. Thus, one skilled in the art would not be likely to use a non-woven fabric with the alloyed negative electrode.

Furthermore, the Examiner alleges that Applicants have not shown criticality since Comparative Example 1 is not being relied upon in the rejection. This is explained because none of the primary references in the prior art have only one non-woven layer. Applicants disagree. As was set forth in the previous responses, Applicants showed how Comparative Example 4, which includes a polyethylene film and a heat-resistant layer, has far worse discharge characteristics, capacity retention rate, and safety during nail penetration test than Examples 5 and 24. Moreover, the comparison between Comparative Examples 2 and 4 showed that a heat-resistant layer combined with a microporous film causes discharge characteristics to deteriorate, which is contrary to what one skilled in the art would determine based on the teachings of the cited prior art. Furthermore, the Examples indeed showed significant effects, since the combination of non-woven fabric and a heat-resistant layer exhibit better discharge characteristics and further, overcome the disadvantage of a percent defective of 18% and exhibit improved safety.

As such, Applicants submit that Yamashita and Miyasaka do not render amended independent claim 1 obvious. Furthermore, Shi, Fujiwara and Nakamizo do not and are not relied upon to remedy this deficiency.

In order to establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. As is clearly shown, Yamashita, Fujiwara, Miyasaka, Nakamizo and Shi do not disclose or suggest a cylindrical lithium

secondary battery having a design capacity density of  $114 \text{ mAh/cm}^3$  or more comprising: a separator interposed between said positive electrode and said negative electrode; and a non-aqueous electrolyte, wherein said separator comprises non-woven fabric, at least one of said positive electrode and said negative electrode has a porous film that is adhered to a surface thereof, said porous film has a thickness of not less than  $0.5 \text{ }\mu\text{m}$  and not more than  $10 \text{ }\mu\text{m}$ , the non-woven fabric has a thickness of not less than  $15 \text{ }\mu\text{m}$  and not more than  $25 \text{ }\mu\text{m}$ , a total thickness of the porous film and the non-woven fabric is not less than  $15.5 \text{ }\mu\text{m}$  and not more than  $30 \text{ }\mu\text{m}$ , and said porous film comprises alumina and a binder. Therefore, Applicants submit that Yamashita, Fujiwara, Miyasaka, Nakamizo and Shi do not render amended independent claim 1 of the present invention obvious and accordingly, Applicants respectfully request that the § 103(a) rejection of claim 1 be withdrawn.

**IV. All Dependent Claims Are Allowable Because The Independent Claim From Which They Depend Is Allowable**

Under Federal Circuit guidelines, a dependent claim is nonobvious if the independent claim upon which it depends is allowable because all the limitations of the independent claim are contained in the dependent claims, *Hartness International Inc. v. Simplicatic Engineering Co.*, 819 F.2d at 1100, 1108 (Fed. Cir. 1987). Accordingly, as independent claim 1 is patentable for the reasons set forth above, it is respectfully submitted that all pending dependent claims are also in condition for allowance.

**V. Conclusion**

Having fully responded to all matters raised in the Office Action, Applicants submit that all claims are in condition for allowance, an indication of which is respectfully solicited.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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